An Overview of the Ames Lab Simulation, Modeling, and Decision Science Program

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***Abstract*— Power systems, consumer appliances, biofuels, and a wide variety of other energy technologies are all interwoven within a complex fabric that includes built, natural, and human systems. Because of this, designing sustainable energy technologies and solutions requires robust engineering decision-making tools that provide the granularity, detail, and breadth required to understand the impact of a particular engineering decision within their respective complex systems. In this presentation we will briefly discuss the current efforts of the Ames Laboratory Simulation Modeling and Decision Program to develop a computer-based (virtual) unified design environment that encompasses all of the elements needed to support engineering decision-making for complex systems.**

Within this proposed design environment the virtual product, process, or system will be explored, built, revised, and "test driven," and the virtual prototypes will respond in the same way as a physical product. In this way design ideas could be explored, modified, and compared on the basis of both the quantitative and qualitative needs of the product or system. That is, the goal is to create engineering-based integrated computational environments that provide experiences similar to developing and then playing a massive online game while accurately portraying an engineered product. This sets a very high standard for model fidelity, model integration capabilities, real-time interaction, and data management that has not yet been achieved.

Current integration projects including development of a cyber-physical system for hybrid power plant design and testing, integration of CAD models and data to facilitate improved manufacturing processes, and large-scale integration of multiple model sets to address the availability of agricultural residue will be used to examine the three key aspects of these proposed virtual environments—constituency, articulation, and convergence.

Keywords—complex systems; system modeling; decision science; virtual environments